**Applied Science BTEC Level 3 Extended certificate – Bridging work Y11-Y12**

Thank you for choosing to study BTEC Applied Science at Park High School – you have made an excellent decision.

The jump from GCSE to BTEC Level 3 is a big step up, so it is vital that you have a key understanding of the topics covered at KS4.

Therefore, it is important you complete the below tasks before September.

1. Students currently studying at Park High School in Year 11 should complete ALL the GCSE Biology, Chemistry and Physics Kerboodle checkpoint tasks which have been set online. These need to be completed by the **12th of August 2021**. Students are expected to score at least 70% in each task. This will be taken into consideration for the enrolment process on to the BTEC course. If you have any queries, please contact Miss Selva via email at rselvarajah.310@parkhighstanmore.org.uk.

Please ensure that you continue to review all GCSE content so that you have a solid foundation to starting KS5.

1. Purchase the Pearson BTEC National Applied Science textbook (Student book 1) ISBN: 9781292134093
2. Purchase a lab coat
3. The first topics you will be covering on the course will be Unit 1 (Principles and Applications of Science) Chemistry and Physics – please use the internet, GCSE revision guides or old class notes to read over the following topics in advance to the lessons:
* Ionic, covalent and metallic bonding (Chemistry)
* Moles and calculations involving moles (Chemistry)
* Waves (Physics)
* Electromagnetic spectrum (Physics)

On the above topics please complete some pre-reading on the topics and complete a set of notes that you will be ready to show to your teacher in September.

1. Please complete the task below on scientific skills:

### Retrieval questions

You need to be confident about the definitions of terms that describe measurements and results in A Level Chemistry.

Learn the answers to the questions below then cover the answers column with a piece of paper and write as many answers as you can. Check and repeat.

#### Practical science key terms

|  |  |
| --- | --- |
| When is a measurement valid? | when it measures what it is supposed to be measuring |
| When is a result accurate? | when it is close to the true value |
| What are precise results? | when repeat measurements are consistent/agree closely with each other |
| What is repeatability? | how precise repeated measurements are when they are taken by the *same* person, using the *same* equipment, under the *same* conditions |
| What is reproducibility? | how precise repeated measurements are when they are taken by *different* people, using *different* equipment |
| What is the uncertainty of a measurement? | the interval within which the true value is expected to lie |
| Define measurement error | the difference between a measured value and the true value |
| What type of error is caused by results varying around the true value in an unpredictable way? | random error |
| What is a systematic error? | a consistent difference between the measured values and true values |
| What does zero error mean? | a measuring instrument gives a false reading when the true value should be zero |
| Which variable is changed or selected by the investigator? | independent variable |
| What is a dependent variable? | a variable that is measured every time the independent variable is changed |
| Define a fair test | a test in which only the independent variable is allowed to affect the dependent variable |
| What are control variables? | variables that should be kept constant to avoid them affecting the dependent variable |

1. Complete the task below on maths skills in science and balancing equations.

### Maths skills

#### 1 Core mathematical skills

A practical chemist must be proficient in standard form, significant figures, decimal places, SI units, and unit conversion.

##### 1.1 Standard form

In science, very large and very small numbers are usually written in standard form. Standard form is writing a number in the format A × 10x where A is a number from 1 to 10 and x is the number of places you move the decimal place.

For example, to express a large number such as 50 000 mol dm−3 in standard form, A = 5 and x = 4 as there are four numbers after the initial 5.

Therefore, it would be written as 5×104 mol dm−3.

To give a small number such as 0.000 02 Nm2 in standard form, A = 2 and there are five numbers before it so x = −5.

So it is written as 2×10−5 Nm2.

###### Practice questions

1. Change the following values to standard form.

**a** boiling point of sodium chloride: 1413 °C

**b** largest nanoparticles: 0.0 001×10−3 m

**c** number of atoms in 1 mol of water: 1806×1021

1. Change the following values to ordinary numbers.

**a** 5.5×10−6 **b** 2.9×102 **c** 1.115×104 **d** 1.412×10−3 **e** 7.2×101

##### 1.2 Significant figures and decimal places

In chemistry, you are often asked to express numbers to either three or four significant figures. The word significant means to ‘have meaning’. A number that is expressed in significant figures will only have digits that are important to the number’s precision.

It is important to record your data and your answers to calculations to a reasonable number of significant figures. Too many and your answer is claiming an accuracy that it does not have, too few and you are not showing the precision and care required in scientific analysis.

For example, 6.9301 becomes 6.93 if written to three significant figures.

Likewise, 0.000 434 56 is 0.000 435 to three significant figures.

Notice that the zeros before the figure are *not* significant – they just show you how large the number is by the position of the decimal point. Here, a 5 follows the last significant digit, so just as with decimals, it must be rounded up.

Any zeros between the other significant figures are significant. For example, 0.003 018 is 0.003 02 to three significant figures.

Sometimes numbers are expressed to a number of decimal places. The decimal point is a place holder and the number of digits afterwards is the number of decimal places.

For example, the mathematical number pi is 3 to zero decimal places, 3.1 to one decimal place, 3.14 to two decimal places, and 3.142 to three decimal places.

###### Practice questions

1. Give the following values in the stated number of significant figures (s.f.).

**a** 36.937 (3 s.f.) **b** 258 (2 s.f.) **c** 0.043 19 (2 s.f.) **d** 7 999 032 (1 s.f.)

1. Use the equation:

number of molecules = number of moles × 6.02 × 1023 molecules per mole

to calculate the number of molecules in 0.5 moles of oxygen. Write your answer in standard form to 3 s.f.

1. Give the following values in the stated number of decimal places (d.p.).

**a** 4.763 (1 d.p.) **b** 0.543 (2 d.p.) **c** 1.005 (2 d.p.) **d** 1.9996 (3 d.p.)

##### 1.3 Converting units

Units are defined so that, for example, every scientist who measures a mass in kilograms uses the same size for the kilogram and gets the same value for the mass. Scientific measurement depends on standard units – most are *Système International* (SI) units.

If you convert between units and round numbers properly it allows quoted measurements to be understood within the scale of the observations.

|  |  |  |
| --- | --- | --- |
| **Multiplication factor** | **Prefix** | **Symbol** |
| 109 | giga | G |
| 106 | mega | M |
| 103 | kilo | k |
| 10–2 | centi | c |
| 10–3 | milli | m |
| 10–6 | micro | µ |
| 10–9 | nano | n |

Unit conversions are common. For instance, you could be converting an enthalpy change of 488 889 J mol−1 into kJ mol−1. A kilo is 103 so you need to divide by this number or move the decimal point three places to the left.

488 889 ÷ 103 kJ mol−1 = 488.889 kJ mol−1

Converting from mJ mol−1 to kJ mol−1, you need to go from 103 to 10−3, or move the decimal point six places to the left.

333 mJ mol−1 is 0.000 333 kJ mol−1

If you want to convert from 333 mJ mol−1 to nJ mol−1, you would have to go from 10−9 to 10−3, or move the decimal point six places to the right.

333 mJ mol−1 is 333 000 000 nJ mol−1

###### Practice question

1. Calculate the following unit conversions.

**a** 300 µm to m

**b** 5 MJ to mJ

**c** 10 GW to kW

#### 2 Balancing chemical equations

##### 2.1 Conservation of mass

When new substances are made during chemical reactions, atoms are not created or destroyed – they just become rearranged in new ways. So, there is always the same number of each type of atom before and after the reaction, and the total mass before the reaction is the same as the total mass after the reaction. This is known as the conservation of mass.

You need to be able to use the principle of conservation of mass to write formulae, and balanced chemical equations and half equations.

##### 2.2 Balancing an equation

The equation below shows the correct formulae but it is not balanced.

H2 + O2 → H2O

While there are two hydrogen atoms on both sides of the equation, there is only one oxygen atom on the right-hand side of the equation against two oxygen atoms on the left-hand side. Therefore, a two must be placed before the H2O.

H2 + O2 → 2H2O

Now the oxygen atoms are balanced but the hydrogen atoms are no longer balanced. A two must be placed in front of the H2.

2H2 + O2 → 2H2O

The number of hydrogen and oxygen atoms is the same on both sides, so the equation is balanced.

###### Practice question

1. Balance the following equations.

**a** C + O2 → CO

**b** N2 + H2 → NH3

**c** C2H4 + O2 → H2O + CO2

##### 2.3 Balancing an equation with fractions

To balance the equation below:

C2H6 + O2 → CO2 + H2O

* Place a two before the CO2 to balance the carbon atoms.
* Place a three in front of the H2O to balance the hydrogen atoms.

 C2H6 + O2 → 2CO2 + 3H2O

There are now four oxygen atoms in the carbon dioxide molecules plus three oxygen atoms in the water molecules, giving a total of seven oxygen atoms on the product side.

* To balance the equation, place three and a half in front of the O2.

 C2H6 + 3½O2 → 2CO2 + 3H2O

* Finally, multiply the equation by 2 to get whole numbers.

 2C2H6 + 7O2 → 4CO2 + 6H2O

###### Practice question

1. Balance the equations below.

**a** C6H14 + O2 → CO2 + H2O

**b** NH2CH2COOH + O2 → CO2 + H2O + N2

##### 2.4 Balancing an equation with brackets

Ca(OH)2 + HCl → CaCl2 + H2O

Here the brackets around the hydroxide (OH−) group show that the Ca(OH)2 unit contains one calcium atom, two oxygen atoms, and two hydrogen atoms.

To balance the equation, place a two before the HCl and another before the H2O.

Ca(OH)2 + 2HCl → CaCl2 + 2H2O

###### Practice question

1. Balance the equations below.

**a** Mg(OH)2 + HNO3 → Mg(NO3)2 + H2O

**b** Fe(NO3)2 + Na3PO4 → Fe3(PO4)2 + NaNO3

In your first lesson please ensure you have all of the above work with you, that has been neatly set out and presented. I look forward to meeting you all.

Miss Selva