Transition Pack for AAQ Applied Science

A guide to help you get ready for AAQ Applied Science courses.

This pack contains a programme of activities and resources to prepare you to start AA Applied Science in September. It is aimed to be used after you complete your GCSE throughout the remainder of the summer term and over the summer holidays to ensure you are ready to start your course in September.

Contents:

Pre-Knowledge Topics

Maths

Symbols and Prefixes

Prefix	Symbol	Power of ten
Nano	n	**x 10^{-9}**
Micro	μ	**x 10^{-6}**
Milli	m	**x 10^{-3}**
Centi	c	**x 10^{-2}**
Kilo	k	**x 10^{3}**
Mega	M	**x 10^{6}**
Giga	**G**	**x 10^{9}**

Task: Solve the following:

1. How many metres in 2.4 km?
2. How many joules in 8.1 MJ?
3. Convert 326 GW into W. Convert 54 600 mm into m.
4. How many grams in 240 kg?
5. Convert 0.18 nm into m.
6. Convert 632 nm into m. Express in standard form.
7. Convert 1002 mV into V. Express in standard form.
8. How many eV in 0.511 MeV? Express in standard form.
9. How many m in 11 km? Express in standard form.

Significant Figures

At level 3 you will be expected to use an appropriate number of significant figures in your answers. The number of significant figures you should use is the same as the number of significant figures in the data you are given. You can never be more precise than the data you are given so if that is given to 3 significant your answer should be too. E.g. Distance = 8.24m, time = 1.23s therefore speed = 6.75m/s

The website below summarises the rules and how to round correctly.

http://www.purplemath.com/modules/rounding2.htm

Task: Give the following to 3 significant figures:

1. 3.4527 2. 40.691 3. 0.838991 4. 1.0247

Calculate the following to a suitable number of significant figures:

1. 63.2 ÷78.1 = 2. 39 + 78 + 120 =

3. (3.4+3.7+3.2) ÷3 = 4. 0.0256 x 0.129 =

Pre-Knowledge Topics

Biology

The cell is a unifying concept in biology, you will come across it many times during your two years of A level study. Prokaryotic and eukaryotic cells can be distinguished on the basis of their structure and ultrastructure.

In complex multicellular organisms cells are organised into tissues, tissues into organs and organs into systems.

Read the information on these websites (you could make more Cornell notes if you wish):

http://www.s-cool.co.uk/a-level/biology/cells-and-organelles

http://www.bbc.co.uk/education/guides/zvjycdm/revision

And take a look at these videos: https://www.youtube.com/watch?v=gcTuQpuJyD8

https://www.youtube.com/watch?v=L0k-enzoeOM https://www.youtube.com/watch?v=qCLmR9-YY7o

Task:

Produce a one page revision guide to share with your class in September summarising one of the following topics: Cells and Cell Ultrastructure or Prokaryotes and Eukaryotes.

Whichever topic you choose, your revision guide should include:

- Key words and definitions
- Clearly labelled diagrams
- Short explanations of key ideas or processes.

Pre-Knowledge Topics

Chemistry

Task: To answer the following questions:

Chemistry Topic 1 – Electronic structure, how electrons are arranged around the nucleus

A periodic table can give you the proton / atomic number of an element, this also tells you how many electrons are in the atom.

You will have used the rule of electrons shell filling, where:

The first shell holds up to 2 electrons, the second up to 8, the third up to 8 and the fourth up to 18 (or you may have been told 8).

Atomic number =3, electrons = 3, arrangement 2 in the first shell and 1 in the second or Li = 2,1

At A level you will learn that the electron structure is more complex than this and can be used to explain a lot of the chemical properties of elements.

The 'shells' can be broken down into 'orbitals', which are given letters: 's' orbitals, 'p' orbitals and 'd' orbitals.

You can read about orbitals here: http://bit.ly/pixlchem1

http://www.chemguide.co.uk/atoms/properties/atomorbs.html#top

Now that you are familiar with s, p and d orbitals try these problems. Write your answer in the format: 1s2, 2s2, 2p6 etc.

Q1. Write out the electron configuration of:

a) Ca b) Al c) S d) Cl e) Ar f) Fe g) V h) Ni i) Cu j) Zn k) As Q2. Extension question, can you write out the electron arrangement of the following ions:

a) K+ b) O2- c) Zn2+ d) V5+ e) Co2+

Chemistry Topic 2 – Measuring chemicals – the mole

From this point on you need to be using an A level periodic table, not a GCSE one. You can view one here:

http://bit.ly/pixlpertab

https://secondaryscience4all.files.wordpress.com/2014/08/filestore_aqa_org_uk_subjects_aqa-2420-whttps://secondaryscience4all.files.wordpress.com/2014/08/filestore_aqa_org_uk_subjects_aqa-2420-w-trb-ptds_pdf.pngtrb-ptds_pdf.png

Now that we have our chemical equations balanced, we need to be able to use them in order to work out masses of chemicals we need or we can produce.

The ***mole*** is the chemists equivalent of a dozen. Atoms are so small that we cannot count them out individually, we weigh out chemicals.

For example: magnesium + sulfur ----------→ magnesium sulfide

Mg + S ----------→ MgS

We can see that one atom of magnesium will react with one atom of sulfu. If we had to weigh out the atoms we need to know how heavy each atom is.

From the periodic table: Mg = 24.3 and S = 32.1

If I weigh out exactly 24.3g of magnesium this will be 1 mole of magnesium. If we counted how many atoms were present in this mass it would be a huge number (6.02×10^{23}!!!!). If I weigh out 32.1g of sulfur then I would have 1 mole of sulfur atoms.

So 24.3g of Mg will react precisely with 32.1g of sulfur, and will make 56.4g of magnesium sulfide.

Here is a comprehensive page on measuring moles, there are a number of descriptions, videos and practice problems. You will find the first 6 tutorials of most use here, and problem sets 1 to 3.

http://bit.ly/pixlchem9
http://www.chemteam.info/Mole/Mole.html

Q1. Answer the following questions on moles.

How many moles of phosphorus pentoxide (P_4O_{10}) are in 85.2g?

How many moles of potassium are in 73.56g of potassium chlorate (V) ($KClO_3$)?

How many moles of water are in 249.6g of hydrated copper sulfate(VI) ($CuSO_4.5H_2O$)? For this one, you need to be aware the dot followed by $5H_2O$ means that the molecule comes with 5 water molecules so these have to be counted in as part of the molecules mass.

What is the mass of 0.125 moles of tin sulfate ($SnSO_4$)?

If I have 2.4g of magnesium, how many g of oxygen(O_2) will I need to react completely with the magnesium?

2Mg +O -----→ MgO

Pre-Knowledge Topics

Physics

You have studied different types of waves and used the wave equation to calculate speed, frequency and wavelength. You will also have studied reflection and refraction.

Use the following links to review this topic.

https://www.bbc.co.uk/bitesize/guides/zwkn2nb/revision/1

https://www.khanacademy.org/science/physics/mechanical-waves-andhttps://www.khanacademy.org/science/physics/mechanical-waves-and-sound/mechanicalwaves/v/introduction-to-wavessound/mechanicalwaves/v/introduction-to-waves

Task: Create a power point presentation that teaches the following to other students

1) Draw a diagram showing the refraction of a wave through a rectangular glass block. Explain why the ray of light takes this path.

2) Describe the difference between a longitudinal and transverse waves and give an example of each

3) Draw a wave and label the wavelength and amplitude

Task 3. Questions:

You have also been issued with some biology, chemistry and physics questions which you should complete some independent research on in order to be able to answer the questions. They will give you an idea of the nature/level of questions that you will be asked in the externally assessed units.

Section A – Periodicity and Properties of

1 Hydrogen and chlorine atoms form a covalent molecule called hydrogen chloride that is a gas at room temperature and can be hazardous as it irritates the eyes.

(a) Describe the force between hydrogen and chlorine in this molecule. 1 mark

(b) Draw a dot and cross diagram to show the arrangement of the outer electrons in this molecule.

2 marks

Here is a table showing typical bond lengths and energy for some simple covalent molecules.

Molecule	Bond length (Å)	Bond Energy (kJ mol $^{-1}$)
H – F	0.92	565
H – Cl	1.27	430
H – Br	1.41	365

(c) Describe and explain the trend in bond length and bond strength in Group 7 of the periodic table.

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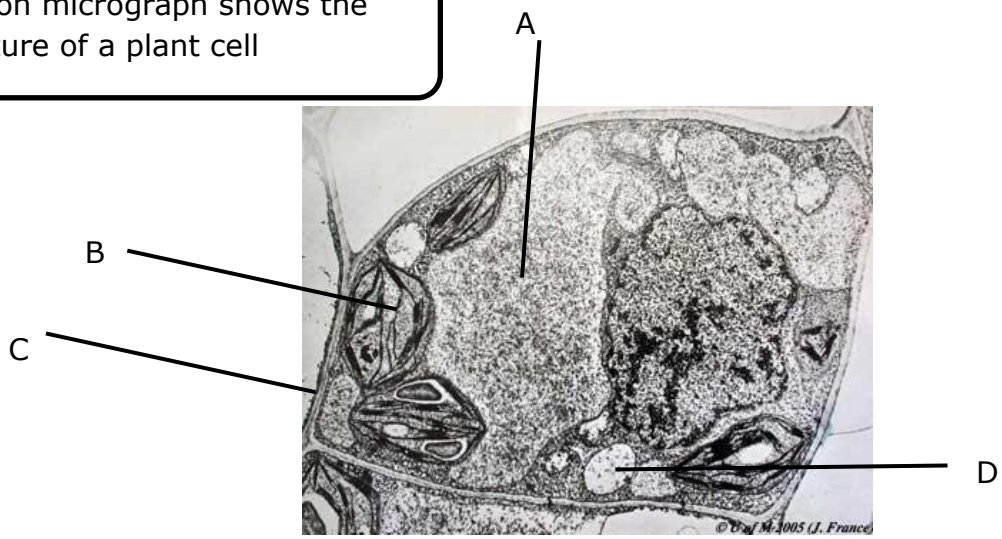
Total for Question 1 = 7 marks

SECTION B: Structures and Functions of Cells and Tissues

2 The electron micrograph shows the ultrastructure of a plant cell



(source http://umaitoba.ca/Biology/BIOL1020/lab3/biolab3_2.html)

(a) (i) Which part of the cell shows the chloroplast?

☐ A ☐ B ☐ C ☐ D

1 mark

(ii) State the function of the chloroplast.

1 mark

(iii) Describe two similarities and two differences between plant and animal cells.

Similarities

Differences

The image was taken at x5000 magnification

4 marks

(iv) Calculate the actual width of the cell

Show your working

2 marks

Total for Question 6 = 8 marks

Section C – Waves in Communication

10 A fibre optic cable is made of thin, flexible glass and is used to transmit electromagnetic radiation.

1 mark

(a) Give one use of fibre optics in communication.

When a fibre optic cable is used, little energy is lost over very long distances.

3 marks

(b) Explain how energy is transmitted through a fibre optic cable.

Total for Question 10 = 4 marks

The Periodic Table of Elements

1	2											3	4	5	6	7	0 (8) (18)
							1.0 H hydrogen 1										4.0 He helium 2
(1)	(2)		Key									(13)	(14)	(15)	(16)	(17)	
6.9 Li lithium 3	9.0 Be beryllium 4		relative atomic mass atomic symbol name atomic (proton) number									10.8 B boron 5	12.0 C carbon 6	14.0 N nitrogen 7	16.0 O oxygen 8	19.0 F fluorine 9	20.2 Ne neon 10
23.0 Na sodium 11	24.3 Mg magnesium 12	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	27.0 Al aluminium 13	28.1 Si silicon 14	31.0 P phosphorus 15	32.1 S sulfur 16	35.5 Cl chlorine 17	39.9 Ar argon 18
39.1 K potassium 19	40.1 Ca calcium 20	45.0 Sc scandium 21	47.9 Ti titanium 22	50.9 V vanadium 23	52.0 Cr chromium 24	54.9 Mn manganese 25	55.8 Fe iron 26	58.9 Co cobalt 27	58.7 Ni nickel 28	63.5 Cu copper 29	65.4 Zn zinc 30	69.7 Ga gallium 31	72.6 Ge germanium 32	74.9 As arsenic 33	79.0 Se selenium 34	79.9 Br bromine 35	83.8 Kr krypton 36
85.5 Rb rubidium 37	87.6 Sr strontium 38	88.9 Y yttrium 39	91.2 Zr zirconium 40	92.9 Nb niobium 41	95.9 Mo molybdenum 42	[98] Tc technetium 43	101.1 Ru ruthenium 44	102.9 Rh rhodium 45	106.4 Pd palladium 46	107.9 Ag silver 47	112.4 Cd cadmium 48	114.8 In indium 49	118.7 Sn tin 50	121.8 Sb antimony 51	127.6 Te tellurium 52	126.9 I iodine 53	131.3 Xe xenon 54
132.9 Cs caesium 55	137.3 Ba barium 56	138.9 La* lanthanum 57	178.5 Hf hafnium 72	180.9 Ta tantalum 73	183.8 W tungsten 74	186.2 Re rhenium 75	190.2 Os osmium 76	192.2 Ir iridium 77	195.1 Pt platinum 78	197.0 Au gold 79	200.6 Hg mercury 80	204.4 Tl thallium 81	207.2 Pb lead 82	209.0 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							

Elements with atomic numbers 112-116 have been reported but not fully authenticated

* Lanthanide series	140 Ce cerium 58	141 Pr praseodymium 59	144 Nd neodymium 60	[147] Pm promethium 61	150 Sm samarium 62	152 Eu europium 63	157 Gd gadolinium 64	159 Tb terbium 65	163 Dy dysprosium 66	165 Ho holmium 67	167 Er erbium 68	169 Tm thulium 69	173 Yb ytterbium 70	175 Lu lutetium 71
* Actinide series	232 Th thorium 90	[231] Pa protactinium 91	238 U uranium 92	[237] Np neptunium 93	[242] Pu plutonium 94	[243] Am americium 95	[247] Cm curium 96	[245] Bk berkelium 97	[251] Cf californium 98	[254] Es einsteinium 99	[253] Fm fermium 100	[256] Md mendelevium 101	[254] No nobelium 102	[257] Lr lawrencium 103

Formulae Sheet

Wave speed	$v = f\lambda$
Speed of a transverse wave on a string	$v = \sqrt{\frac{T}{\mu}}$
Refractive index	$n = \frac{c}{v} = \frac{\sin i}{\sin r}$
Critical angle	$\sin c = \frac{1}{n}$
Inverse square law in relation to the intensity of a wave	$I = \frac{k}{r^2}$

Assignment brief

Qualification	Pearson BTEC Level 3 National EXTENDED CERTIFICATE in Applied Science
Unit number and title	Unit 2 Practical Scientific procedures & techniques
Assessor name	H Bowman
Date issued	Tuesday 9th July 2024
Deadline	Monday 9th September 2024

Assignment title	T: Considering Applied Science?

Purpose of this assignment - The purpose of this assignment is to show that you can work in the investigative way needed for the Applied Science course

Scenario – You work in the research & development lab of Hinchingbrooke Hospital. Your supervisor has decided it is time for you to review the training you have been given in your induction period. This will include you demonstrating your knowledge and understanding of the Science used in the lab.

You have 4 hours of learning outside of the classroom.

You have 3 research activities

1. Cells
2. Catching a cheat
3. Waves

You need to take notes effectively (you could use the Cornell system). Your notes must include:

- Labelled diagrams
- Key words
- Demonstrate understanding by application to real life

Research activities

Topic 1 Cells

a) Use the link https://www.stem.org.uk/resources/elibrary/resource/34589/cell-suitable-home-teaching

b) Write notes (using Cornell note system); include diagrams, key words & explain why the article is important in real life

c) Create a piece of display work for cells

Topic 2
a) Use the link https://www.stem.org.uk/resources/elibrary/resource/348453/catching-cheat#&gid=undefined&pid=1

> Catching a cheat | STEM
>
> This Catalyst article looks at analytical chemists, who are involved in many kinds of testing, including drug testing to catch che
> from Catalyst: Secondary Science Review 2017, Volume 27, Issue 3. Catalyst is a science magazine for students aged 14-19 ye
> print copies of the magazine can be purchased from Mindsets.
>
> www.stem.org.uk

b) Write notes (using the Cornell note system): include diagrams, key words and explain why this article is important in real life

c) Write a short report on "Catching a cheat"

Topic 3
a) Use the link
b) Write notes including diagrams, key words and why the article is important to real life (use the Cornell note system)
c) Write a PowerPoint of your understanding of waves that teachers the up & coming trainees to the research & development lab at the Hospital.

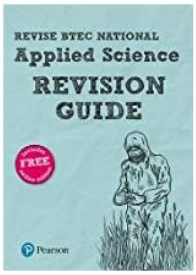
https://www.physicsclassroom.com/class/sound/Lesson-1/Sound-is-a-Mechanical-Wave
The sound produced by the bell cannot be heard

This provides evidence for P1 P2 M1 M2 D1

Evidence checklist	
	[tick boxes]
Task 1: Notes and poster on cells	
Task 2: Notes and report on "catching a cheat"	
Task 3: Notes and a powerpoint on waves	

Sources of information

https://www.amazon.co.uk/s?k=btec+applied+science+level+3&i=stripbooks&crid=SJFTSQULQVLZ&sprefix=BTEC+Applied+science+%2Cstripbooks%2C145&ref=nb_sb_ss_i_1_21



Below is a link to the specification for the BTEC level 3 Applied Science course:
https://qualifications.pearson.com/en/qualifications/btec-nationals/applied-science-2016.html

Make sure you are on the correct tab: Extended certificate (A-level equivalent)

Biology

https://alevelnotes.com/notes/biology

Chemistry

Use the following resources for extra support:

- http://www.creative-chemistry.org.uk/
- http://www.chembook.co.uk/
- http://www.franklychemistry.co.uk/

Physics

http://www.physics.org/aboutus.asp There are multiple web links within the tasks

https://www.physicsclassroom.com/