Year 11 CHEMISTRY Sem 1 2021
ANSWER KEY

Section One: Multiple–choice **25% (25 Marks)**

1	A
2	C
3	D
4	A
5	C
6	D
7	C
8	B
9	A
10	B
11	D
12	A
13	C

14	D
15	D
16	C
17	C
18	B
19	D
20	A
21	B
22	B
23	B
24	D
25	A

A = 6
B = 6
C = 7
D = 6

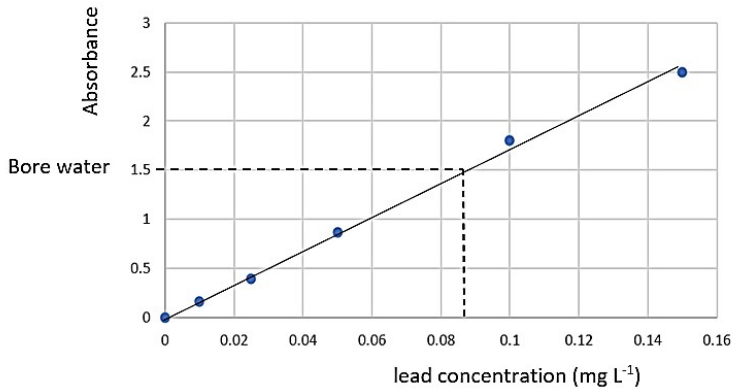
Section Two: Short Answer **35% (70 Marks)**

Question 26 **(9 marks)**

Lead concentration (mg L^{-1})	0.010	0.025	0.050	0.10	0.15
Absorbance	0.16	0.41	0.87	1.8	2.5

Bore water
1.5

(a) Draw a suitable graph of the results on the grid below and, using the graph, explain that the bore water is safe to use for watering plants but not safe for drinking. (6 marks)



Description	Marks
Axes labelled and scales correct	2
Line of best fit (not join dots) for standard solutions	1
LOBF goes through origin	1
Bore water shown on graph or refers to graph in answer	1
Not safe for drinking	1
Total	**6**

(b) Explain why each element has a unique absorption spectrum. (3 marks)

Description	Marks
The energy of each electron level is different for each atom	1
Therefore, the energy absorbed in electron transitions are unique to that element	1
So, each element has a unique absorption spectrum	1
Total	**3**

Question 27 **(8 marks)**

(a) Using information from the data booklet, determine the approximate percentage abundance of the two main isotopes of boron ^{10}B and ^{11}B in a sample of boron. Show your working. (4 marks)

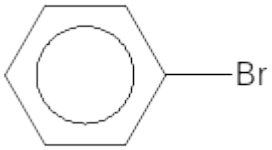
Description	Marks
Assume X% of isotope 11 and (100 – X)% of isotope 10	1
$10.82 = \frac{(11 \times X) + (10 \times (100 - X))}{100}$	1
X = 82 = 82% of isotope 11	1
Therefore 18% of isotope 10 (must state this %)	1
Total	**4**

(b) List 4 key steps in the mass spectrometry process to determine the abundance of these isotopes in a sample of boron. (4 marks)

Description	Marks
Mass spectrometry: 1. vaporises and ionises a sample of boron	1
2. accelerates the particles through a magnetic field	1
3. which separates the various isotope ions	1
4. and measures their relative intensity and therefore abundance	1
Total	**4**

Question 28 **(7 marks)**

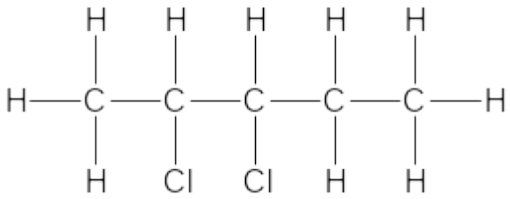
(a) Draw a full structural formula and name the main organic product in the reaction between benzene and bromine liquid in the presence UV light. (3 marks)

Description	Marks
	
Benzene structure	1
Bromine bonded	1
Name: bromobenzene	1
Total	**3**

(b) Name the other product in this reaction. (1 mark)

Description	Marks
Hydrogen bromide (do not accept HBr)	1
Total	**1**

(c) Draw a full structural formula for and name the main organic product in the reaction between pent–2–ene and chlorine gas. (3 marks)

Description	Marks
	
5 carbon backbone	1
Chlorine on carbon #2 and #3	1
Name: 2,3–dichloropentane	1
Total	**3**

Question 29 **(3 marks)**

Balance the following equations. Each formula is correctly written.

(a) $Ca(OH)_2(aq) + HC\ell(aq) \rightarrow CaC\ell_2(aq) + H_2O(\ell)$ (1 mark)

Description	Marks
Equation correctly balanced $Ca(OH)_2(aq) + 2\ HC\ell(aq) \rightarrow CaC\ell_2(aq) + 2\ H_2O(\ell)$	1
Total	**1**

(b) $FeC\ell_3(aq) + Mg(s) \rightarrow MgC\ell_2(aq) + Fe(s)$ (1 mark)

Description	Marks
Equation correctly balanced $2\ FeC\ell_3(aq) + 3\ Mg(s) \rightarrow 3\ MgC\ell_2(aq) + 2\ Fe(s)$	1
Total	**1**

(c) $(NH_4)_2CO_3(s) + HNO_3(aq) \rightarrow NH_4NO_3(aq)\ CO_2(g) + H_2O(\ell)$ (1 mark)

Description	Marks
Equation correctly balanced $(NH_4)_2CO_3(s) + 2\ HNO_3(aq) \rightarrow 2\ NH_4NO_3(aq) + CO_2(g) + H_2O(\ell)$	1
Total	**1**

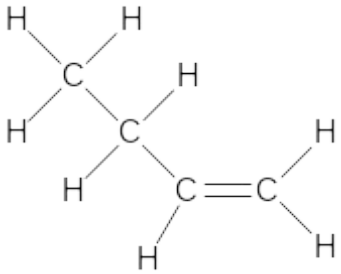
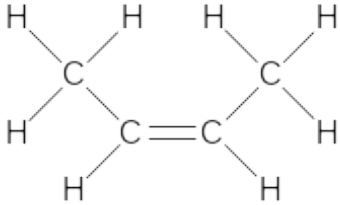
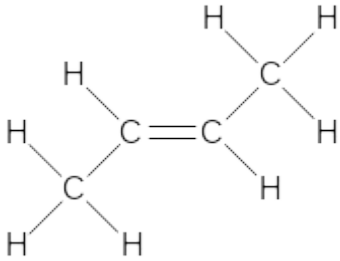
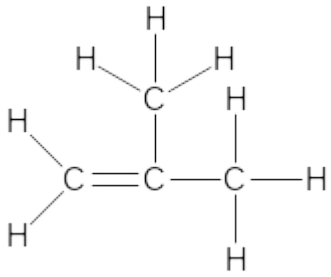
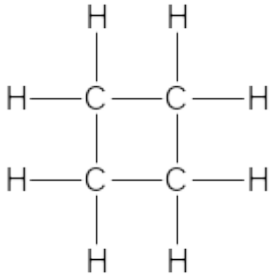
Question 30 **(9 marks)**

Complete the table describing some properties of carbon graphite, carbon dioxide and silicon carbide (SiC) by circling the correct terms. (9 marks)

Description				Marks
	Graphite	**Carbon dioxide**	**Silicon carbide**	
Strength of the solid structure	low	low	high	3
Melting point	high	low	high	3
Electrical conductivity	high	low	low	3
			Total	**9**

Question 31 **(8 marks)**

Draw full structural formulas for and name 4 possible isomers of C_4H_8. (8 marks)

Description	Marks
Any 4 suitable correctly drawn structures and names	
 but–1–ene	**2**
 *cis*–but–2–ene	**2**
 *trans*–but–2–ene	**2**
 methylpropene	**2**
 cyclobutane	**2**
Total	**8**

Question 32 **(7 marks)**

(a) Explain, with the aid of a labelled diagram, the structure of gold that allows it to conduct electricity. (3 marks)

Description	Marks
Delocalised electrons conduct electricity/carry charge	1
Diagram shows: regular arrangement of positive ions (Au^{3+})	1
interspaced with electrons	1
Total	**3**

(b) What size range are nanoparticles? (1 mark)

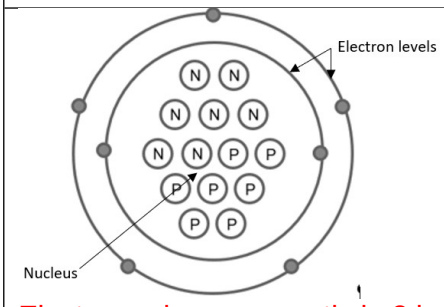
Description	Marks
1–100 nanometres	1
Total	**1**

(c) If gold is harmless to the body can it be assumed gold nanoparticles will also be harmless Justify your answer. (3 marks)

Description	Marks
no	1
Nanoparticles and bulk materials have very different properties	1
and due to their small size there may be a danger from breathing in nanoparticles OR an effect on the body's cells	1
Total	**3**

Question 33 **(7 marks)**

(a) Draw and label a diagram of the structure of a nitrogen atom showing the particles in the nucleus and electron levels. (4 marks)

Description	Marks
 Electrons shown correctly in 2 levels 7 protons and a similar number of neutrons shown in the centre (nucleus) Nucleus and electron levels labelled	 1 1 2
Total	**4**

(b) Briefly describe (or draw) how J.J. Thomson's model of this atom might look. (1 mark)

Description	Marks
 diagram should show electrons inside a circle (positively charged sphere) OR describe as: small negatively charged electrons embedded in a large uniformly positive sphere	1
Total	**1**

(c) Which subatomic particle did Sir James Chadwick discover in 1932 and why was this particle the last to be discovered? (2 marks)

Description	Marks
neutron	1
Difficult to detect with equipment (available at the time) as it has no charge	1
Total	**2**

Question 34 **(12 marks)**

(a) By referring to its bonding and structure explain why aluminium is a solid at room temperature. (3 marks)

Description	Marks
Forms a 3D lattice of metallic bonds	1
with a strong electrostatic force of attraction (between positive ions and delocalised electrons)	1
Requires a large amount of energy to break these bonds (so it has a high melting point/is a solid)	1
Total	**3**

(b) By referring to its bonding and structure explain why chlorine is a gas at room temperature. (3 marks)

Description	Marks
Chlorine forms diatomic molecules	1
very weak forces of attraction between chlorine molecules	1
Very little energy required to break intermolecular forces (so it has a low melting point/is a gas)	1
Total	**3**

(c) State the trend in electronegativity for Period 3 elements. (1 mark)

Description	Marks
Left to right increase	1
Total	**1**

(d) Refer to the electron configurations of the elements chlorine and aluminium to explain why aluminium chloride has the formula $A\ell C\ell_3$. (5 marks)

Description	Marks
$A\ell$ electron configuration 2.8.3	1
$C\ell$ electron configuration 2.8.7	1
Aluminium has 3 valence electrons to 'give away' to have a full shell	1
Chlorine accepts 1 electron to have a full shell	1
3 chlorines are needed to accept the 3 electrons from aluminium hence $A\ell C\ell_3$	1
Total	**5**

End of Section Two

Section Three: Extended answer **40% (80 Marks)**

Question 35 **(21 marks)**

(a) List the names of three biofuels and three fossil fuels. (6 marks)

Description	Marks
Biofuels (accept other suitable alternatives)	
Biogas	**1**
Biodiesel	**1**
bioethanol	**1**
Fossil fuels (accept other suitable alternatives)	
Coal	**1**
Oil	**1**
Natural gas	**1**
	6

(b) Compare the general differences between biofuels and fossil fuels by completing the table below (Circle correct choice) (6 marks)

Description			Marks
	Biofuel	**Fossil fuel**	
Carbon emissions	high	high	**2**
Sulfur emissions	low	high	**2**
Sustainability	high	low	**2**
		Total	**6**

$C_{19}H_{36}O_2(\ell) + 27\ O_2(g) \rightarrow 19\ CO_2(g) + 18\ H_2O(\ell)$

(c) Calculate the number of moles of CO_2 emissions produced from 1.00 kg of biodiesel. (4 marks)

Description		Marks
M(biodiesel) = 12.01 × 19 + 1.008 × 36 + 16.0 × 2 = 296.478		**1**
n(biodiesel) = 1000/296.478 = 3.3729 mol		**1**
Stoichiometry $n(CO_2) = 19 \times n(\text{biodiesel})$		**1**
$n(CO_2) = 19 \times 3.3729 = 64.0857 = 64.1$ mol		**1**
Total		**4**

(d) Given that 1.00 kg of biodiesel has a volume of about 1.14 L; calculate the mass of oxygen gas required to completely burn 1.00 L of biofuel vapour. (5 marks)

Description	Marks
m(1.00 L biodiesel) = 1000/1.14 = 877.193 g	**1**
n(biodiesel) = 877.193/296.478 = 2.9587 mol	**1**
Stoichiometry $n(O_2) = 27 \times n(\text{biodiesel})$	**1**
$n(O_2) = 27 \times 2.9587 = 79.885$ mol	**1**
$m(O_2) = 79.885 \times 16.00 \times 2 = 2556$ g (2.56×10^3 g)	**1**
Total	**5**

Question 36 **(17 marks)**

(a) State one safety issue that could arise and how the risk could be minimised. (2 marks)

Description	Marks
Risk : flammable liquid, liquid harmful on skin, harmful vapours to breathe in	1
Minimisation Strategy: any suitable e.g. carry out in fume hood, wear safety glasses and mask	1
Total	**2**

(b) Use the following information about some liquid fuels to write a hypothesis for the experiment. (3 marks)

Liquid fuel	Energy released (kJ g^{-1})
Petrol	48
Diesel	45
Bioethanol	30
Biodiesel	42

Description	Marks
The temperature of the water will increase the most for petrol and least for bioethanol (or similar)	
The hypothesis should link the independent variable (type of fuel)	1
and dependent variable (temperature rise of water)	1
And be testable	1
Total	**3**

(c) Complete the table below describing this experiment (4 marks)

Description		Marks
Two controlled variables	Equipment used	1
	air temperature	1
One possible random error	Air currents/inconsistent measure of volume of water	1
One possible systematic error	Equipment not calibrated: Thermometer/electronic mass balance/measuring cylinder	1
	Total	**4**

(d) Describe the effect random errors have on a set of results and state one way to reduce random errors. (3 marks)

Description	Marks
Increases the standard deviation/causes inconsistency in the results	1
Always present due to limitations in the equipment	1
Take many readings and use the mean	1
Total	**3**

(e) Describe the effect systematic errors have on a set of results and state one way to reduce systematic errors. (3 marks)

Description	Marks
Shift the mean/results consistently higher or lower than the actual value	1
Caused by incorrect technique or calibration	1
Buy more expensive equipment/read scales at eye level/improve the method	1

Total	**3**

(f) After obtaining many results how would the students know the results were reliable? (1 mark)

Description	Marks
If they were grouped closely around the mean	1
Total	**1**

(g) How could the students improve the validity of their experiment? (1 mark)

Description	Marks
Ensure all variables are controlled	1
Total	**1**

Question 37 **(15 marks)**

(a) Briefly describe how they could use evaporation and crystallisation to obtain a sample of solid potassium sulfate. (3 marks)

Description	Marks
Evaporation	
Mixture heated to allow water to evaporate	1
Leaving a more concentrated solution	1
Crystallisation	
Concentrated solution left to allow crystals to form	1
Total	**3**

(b) Explain why the energy required to decompose water is much greater than the energy required to evaporate water. (4 marks)

Description	Marks
In equation 1 weak intermolecular bonds between water molecules are broken	1
(This is a physical change) requiring little energy to separate molecules	1
In equation 2 strong covalent bonds within water molecules are broken	1
(This is a chemical change) which requires larger amounts of energy	1
Total	**4**

(c) Complete the table describing the substances found at A, B and C. (6 marks)

Description			Marks
Substance	**Name of substance**	**Pure substance or mixture?**	
A	water vapour	pure	2
B	Solution/salt water	mixture	2
C	water	pure	2
		Total	**6**

(d) Describe two differences in physical properties that allow separation of salt and water by distillation. (2 marks)

Description	Marks
Salt is soluble in water	1
Water boils at a much lower temperature than salt	1
Total	**2**

Question 38 **(13 marks)**

Nutrient concentration (mg kg^{-1})							
Product	**Ca**	**Cu**	**Fe**	**Mg**	**K**	**P**	**Na**
Table salt	393	0.1	0	84	152	0	427,636
Himalayan salt	1799	0.1	44	1345	2086	29	394,315

The recommended intake of salt per day for an adult is less than 6.00 g (1 teaspoon).

The recommended minimum daily intake of calcium for an adult is 1.00×10^3 g.

(a) Calculate the percentage of this daily intake of calcium provided by 1 teaspoon of Himalayan salt? State your answer to 3 significant figures. (3 marks)

Description	Marks
6 ÷ 1000 × 1799 = 10.794 mg	1
% = 10.794 ÷ 1000 × 100 = 1.0794%	1
Answer to 3 sig fig: 1.08%	1
Total	**3**

(b) If 50.0 g of table salt is dissolved in water and made up to 500.0 mL, calculate the concentration of sodium in g L^{-1} and mol L^{-1}. (4 marks)

Description	Marks
g L^{-1}	
427 636 mg Na in 1 Kg table salt = 21.3818 g in 50.0 g salt	1
21.3818g in 500.0 mL = 42.8 gL^{-1}	1
mol L^{-1}	
n(Na) = 21.3818 ÷ 22.99 = 0.930 mol	1
0.930 in 500.0 mL = 1.86 mol L^{-1}	1
Total	**4**

(c) Under the following headings compare the bonding in sodium and sodium chloride. (6 marks)

Description			Marks
	sodium	**sodium chloride**	
Type of bonding	Metallic(1)	ionic(1)	**2**
Main particles involved in bonding	Positive ions (1) (delocalised) electrons(1)	Positive ions (1) negative ions(1) just states ions = 1 mark	**2**
		Total	**6**

Question 39 **(14 marks)**

(a) Name the elements in Period 2 of the Periodic Table which can exhibit covalent bonding.
(2 marks)

Description	Marks
(beryllium, boron) carbon, oxygen and fluorine (nitrogen not awarded a mark as it is stated in question)	2
one incorrect or missing	1
Total	**2**

(b) Describe a covalent bond. (4 marks)

Description	Marks
(at least) one pair of electrons shared between two atoms	1
Resulting in an electrostatic force of attraction	1
Between the nuclei of the atoms	1
And the shared pair of electrons	1
Total	**4**

$2\ NH_3(g) + H_3PO_4(aq) \rightarrow (NH_4)_2HPO_4(s)$

(c) Calculate the number of atoms of hydrogen in 1 mole of diammonium hydrogen phosphate.
(2 marks)

Description	Marks
9 atoms in $(NH_4)_2HPO_4$	1
$9 \times 6.022 \times 10^{23} = 5.418 \times 10^{24}$	1
Total	**2**

(d) Use the equation above to calculate the minimum mass of phosphoric acid required to react with 10.5 g of ammonia.
(6 marks)

Description	Marks
$M(NH_3) = 17.03$ g	1
$n(NH_3) = 10.5 \div 17.03 = 0.61656$ mol	1
As mol ratio is 2:1	1
$n(H_3PO_4) = 0.61656 \div 2 = 0.30828$ mol	1
$M(H_3PO_4) = 98.00$ g	1
$m(H_3PO_4) = 0.30828 \times 98.00 = 30.2$ g	1
Total	**6**

End of questions