



# Methodist Ladies' College Semester 1, 2015

Question/Answer Booklet

## ATAR CHEMISTRY STAGE 2

Student Name \_\_\_\_\_

Ms Haughton

Mrs Templeton-Knight

### Time allowed for this paper

Reading time before commencing work: 10 minutes

Working time for paper:

Two hours and thirty minutes

### Materials required/recommended for this paper

#### *To be provided by the supervisor*

This Question/Answer Booklet, Multiple-choice Answer Sheet, Chemistry Data Sheet

#### *To be provided by the candidate*

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: up to three non-programmable calculators approved for use in the WACE examinations

**Important note to candidates** No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

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**Structure of this paper**

Section	Number of questions available	Number of questions to be answered	Suggested working time (minutes)	Marks available	Percentage of exam
Section One: Multiple-choice	20	20	40	40	25
Section Two: Short answer	11	11	60	70	45
Section Three: Extended answer	3	3	50	50	30
<b>Total</b>					100

**Instructions to candidates**

1. The rules for the conduct of Western Australian examinations are detailed in the *Year 12 Information Handbook 2015*. Sitting this examination implies that you agree to abide by these rules.
2. Answer the questions according to the following instructions.

Section One: Answer all questions on the separate Multiple-choice Answer Sheet provided. For each question shade the box to indicate your answer. Use only blue or black pen to shade the boxes. If you make a mistake, place a cross through that square then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Sections Two and Three: Write your answers in this Question/Answer Booklet.

3. When calculating numerical answers, show your working or reasoning clearly. Express numerical answers to the appropriate number of significant figures and include appropriate units where applicable.
4. You must be careful to confine your responses to the specific questions asked and to follow any instructions that are specific to a particular question.
5. Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.
  - Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
  - Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question(s) that you are continuing to answer at the top of the page.

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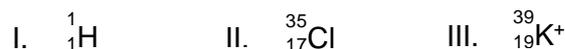
## Section One: Multiple-choice

25% (40 Marks)

This section has 20 questions. Answer **all** questions on the separate Multiple-choice Answer Sheet Provided. For each question shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a cross through that square, do not erase or use correction fluid, and shade your new answer. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question

Suggested working time: 40 minutes

1. Which of the following particles contains more electrons than neutrons?



- (a) I. only  
(b) I. and II. only  
(c) II. only  
(d) II. and III. Only
2. Atoms of elements in a group of the Periodic Table have similar chemical properties. This similarity is most closely related to the atoms'
- (a) number of energy levels (electron shells)  
(b) number of valence electrons  
(c) atomic number  
(d) mass number
3. Which of the following statements is NOT consistent with the kinetic theory of gases?
- (a) Any two gases at the same temperature and pressure will have the same average kinetic energy  
(b) Gas molecules move in rapid, random straight line motion  
(c) The distance between gas particle is large compared to the size of the particles  
(d) There is some loss of energy as gas particles collide as collisions are not perfectly elastic

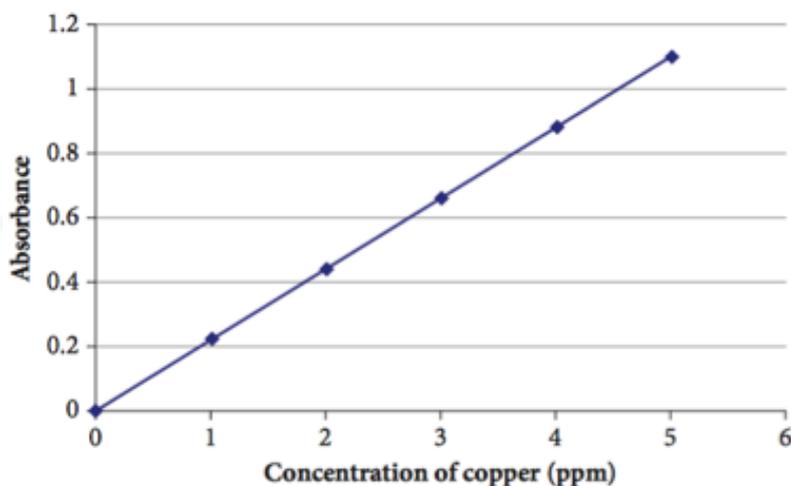
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4. Run-off water from a copper mine is suspected to have dangerous levels of copper in it. A calibration curve is shown below.



A sample of the water from the mine was analyzed and the absorbance value was measured at 0.70. The safe concentration level of copper in run-off water is 2.5ppm. Which of the following is **not true**?

- (a) The sample has a copper concentration of 3 ppm
- (b) The sample has unsafe levels of copper in it.
- (c) The water sample would need an absorbance of less than 0.50 to be within the safe limits of copper content.
- (d) More sample of run-off water would need to be tested in order to obtain an average absorbance level.
5. Consider the following set of successive ionisation energies (MJ/mol) for element X

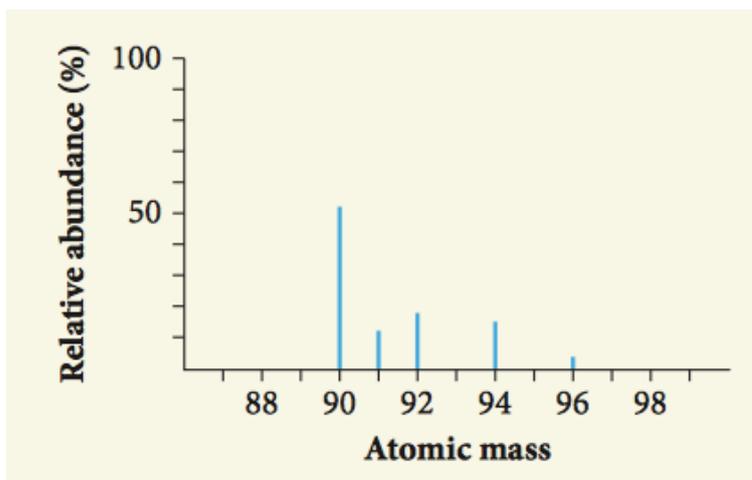
0.74                  1.45                  7.73                  10.5                  13.63

Which of the following statements is correct?

- (a) The element belongs in the same group as sodium
- (b) The formula of the compound formed between X and oxygen is  $X_2O$
- (c) The element will form an  $X^{2+}$  ion
- (d) The element is non-metallic in character.
6. Which one of the following pairs of elements would most likely form a compound that, in its solid state is a molecular solid?
- (a) Hydrogen and lithium
- (b) Chlorine and zinc
- (c) Sulfur and bromine
- (d) Barium and magnesium

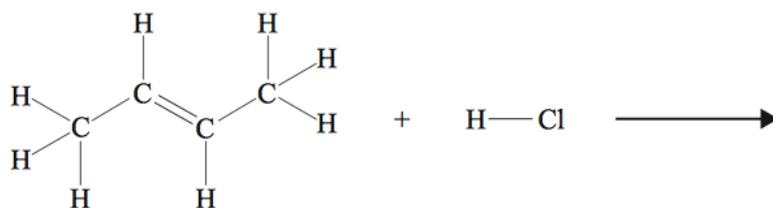
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7. The following diagram is a mass spectrum of an element.



Using the information in the diagram above, which statements are true,

- (i) The element has 5 isotopes with masses, 90,91,92, 94 and 96.
  - (ii) The isotope with mass number 90 is the most abundant
  - (iii) The element is most likely to be molybdenum
  - (iv) The relative atomic mass of the element is close to 94
- (a) (i) and (ii)
  - (b) (i), (ii) and (iii)
  - (c) (i), (ii) and (iv)
  - (d) All of the them
8. The IUPAC name for the organic product(s) of the chemical reaction below is:



- (a) 2-chlorobutane
- (b) trans-2-chlorobutane
- (c) 3-chlorobutane
- (d) an equimolar mixture of 2-chlorobutane and 3-chlorobutane



9. Which of the following statements are true about elements in the periodic table?
- (i) Across a period the size of atoms becomes smaller.
  - (ii) Covalent compounds are formed between elements with similar low to medium first ionisation energies
  - (iii) Elements tend to become more metallic descending a group
  - (iv) Melting point increases descending group 1
  - (v) Chemical reactivity increases descending group 17
- (a) (i), (ii), and (iii)  
(b) (ii), (iii) and (v)  
(c) (i), (iii), (iv) and (v)  
(d) (i) and (iii)
10. Which one of the following does **not** involve a chemical change?
- (a) petrol burns to release carbon dioxide and water
  - (b) water is boiled to form steam
  - (c) rust forms on the surface of an iron nail
  - (d) acid rain dissolves a limestone statue
11. In which pair of compounds do all atoms have the same electron configuration as Neon?
- (a) CO and NaCl
  - (b) CO<sub>2</sub> and Na<sub>3</sub>N
  - (c) F<sub>2</sub>O and CaF<sub>2</sub>
  - (d) NH<sub>3</sub> and MgO
12. Which of the following contains only pure substances?
- (a) magnesium, sodium chloride, air
  - (b) mercury, glucose, sea water
  - (c) nitrogen, calcium, potassium oxide
  - (d) bromine, copper(II) sulfate solution, blood

13. The table below shows the electrical conductivities of substances L, M and N

Substance	Electrical conductivity
L	Conducts electricity in solid and molten states
M	Conducts electricity in aqueous and molten state
N	No electrical conduction in any state

Which alternative gives the most likely identity of the three substances?

	L	M	N
(a)	sulfur	potassium chloride	magnesium
(b)	potassium chloride	magnesium	sulfur
(c)	magnesium	potassium chloride	sulfur
(d)	magnesium	sulfur	potassium chloride

14. Which of the following lists all the species on a nano scale

- (i) Cancer cell, 100,000nm
- (ii) Glucose,  $1 \times 10^{-9}$  m
- (iii) Bacteria,  $1 \times 10^{-6}$  m
- (iv) Antibody,  $1 \times 10^{-8}$  m
- (v) Virus,  $1 \times 10^{-7}$  m

- (a) (ii), (iii), (iv) and (v)
  - (b) (ii), (iii) and (iv)
  - (c) (ii) (iv) and (v)
  - (d) (i), (ii) and (iii)
15. Which one of the following molecules is unsaturated?

- (a)  $(\text{CH}_3)_2\text{CHCH}_3$
- (b)  $(\text{CH}_3)_3\text{CCH}_2\text{CH}_3$
- (c)  $\text{CH}_3\text{CH}_2\text{C}(\text{CH}_3)_2\text{CH}_3$
- (d)  $(\text{CH}_3)_2\text{CCHCH}_3$

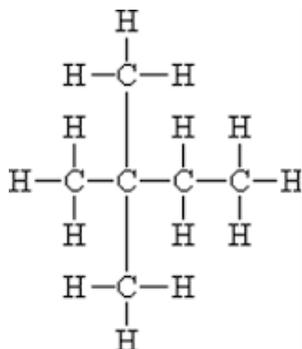


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16. In a particular chlorination reaction, a single hydrogen atom of 2,2-dimethylbutane,  $C_6H_{14}$ , is replaced by one chlorine atom. More than one compound of formula

$C_6H_{13}Cl$  will be formed.

A structure of 2,2-dimethylbutane is provided below.



The number of different carbon compounds that could be formed in this monosubstitution reaction is

- (a) 2  
 (b) 3  
 (c) 4  
 (d) 5
17. Which of the following species are isotopes of the same element?  
 (P, Q, R, S, T are not the actual symbols of the elements).

Element	protons	neutrons	electrons
P	19	24	19
Q	18	20	19
R	20	24	20
S	18	22	18
T	24	26	22

- (a) P and R  
 (b) P and Q  
 (c) S and T  
 (d) Q and S

See next page

18. Which ONE of the following would NOT occur when the pressure of a given mass of gas at constant temperature is increased?
- (a) The number of collisions between the gas molecules and the walls of the container increases.
  - (b) The average kinetic energy of the molecules increases.
  - (c) The volume of the gas decreases
  - (d) The amount in moles of gas remains constant.

19. Pat, Chris, Kim and Lesley each have a mixture. The four mixtures are:

- P** silicon dioxide and glucose
- Q** glucose and water
- R** silicon dioxide and water
- S** glucose, silicon dioxide and water

Unfortunately, we don't know who has which mixture. However, we do know that

- Kim's first step in separating her mixture was to add water.
- Pat did not use filtration at any stage in separating her mixture.
- Lesley's separation did not use as much equipment as Chris's.

Which choice places each mixture with the correct person?

	<b>P</b>	<b>Q</b>	<b>R</b>	<b>S</b>
(a)	Pat	Chris	Lesley	Kim
(b)	Kim	Pat	Chris	Lesley
(c)	Pat	Lesley	Chris	Kim
(d)	Kim	Pat	Lesley	Chris

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20. Which of the following are not isomers of each other?

(a)	$\begin{array}{c} \text{H}_2\text{C}=\text{C}-\text{C}-\text{CH}_3 \\   \quad   \\ \text{H} \quad \text{H}_2 \end{array}$	and	$\text{H}_3\text{C}-\text{C}=\text{C}-\text{CH}_3 \\   \quad   \\ \text{H} \quad \text{H}$
(b)	$\begin{array}{c} \text{H} \quad \text{Br} \\   \quad   \\ \text{C} \\    \\ \text{C} \\   \quad   \\ \text{H} \quad \text{Br} \end{array}$	and	$\begin{array}{c} \text{Br} \quad \text{H} \\   \quad   \\ \text{C} \\    \\ \text{C} \\   \quad   \\ \text{H} \quad \text{Br} \end{array}$
(c)	$\begin{array}{c} \text{CH}_3 \\   \\ \text{CH}_3-\text{CH}_2-\text{CH}-\text{CH}_3 \end{array}$	and	$\begin{array}{c} \text{CH}_3 \\   \\ \text{H}_3\text{C}-\text{C}-\text{CH}_3 \\   \\ \text{CH}_3 \end{array}$
(d)	$\begin{array}{c} \text{H} \quad \text{H} \\   \quad   \\ \text{Cl}-\text{C}-\text{C}-\text{Cl} \\   \quad   \\ \text{H} \quad \text{Cl} \end{array}$	and	$\begin{array}{c} \text{Cl} \quad \text{H} \\   \quad   \\ \text{H}-\text{C}-\text{C}-\text{Cl} \\   \quad   \\ \text{Cl} \quad \text{Cl} \end{array}$

End of Section One

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## Section Two: Short answer

45% (70 Marks)

This section has eleven (11) questions. Answer all questions. Write your answers in the spaces provided.

Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.

- Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
- Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question(s) that you are continuing to answer at the top of the page.

Suggested working time: 60 minutes

## Question 21

(7 marks)

Complete the table below by naming or writing the chemical formulae of each substance.

Name	Formula
phosphorous pentachloride	
	CsMnO <sub>4</sub>
	Fe <sub>2</sub> (CO <sub>3</sub> ) <sub>3</sub>
cobalt dihydrogenphosphate	
	SeO <sub>2</sub>
aluminium oxalate	
	Cr <sub>2</sub> (SO <sub>3</sub> ) <sub>3</sub>

## Question 22

(6 marks)

Complete the following table.

Use the periodic table on the data sheet to determine some of your answers.

Symbol	Atomic No.	Electrons	Protons	Neutrons	Mass number
H				2	
Mg <sup>2+</sup>					24
<sup>20</sup> F <sup>-</sup>					



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## Question 23

(14 marks)

- (a) State the meaning of the term *mass number* of an isotope.

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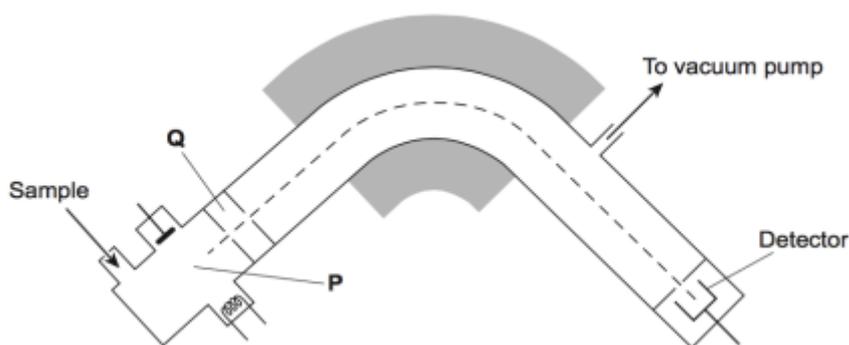
(1 mark)

- (b) Give the symbol of the element that has an isotope with a mass number of 68 and has 38 neutrons in its nucleus.

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(1 mark)

The following shows a simplified diagram of a mass spectrometer.



- (c) State what happens to the sample in the parts labelled **P** and **Q**.

**P** \_\_\_\_\_

**Q** \_\_\_\_\_

(2 marks)

In a mass spectrometer, the isotopes of an element are separated. Two measurements for each isotope are recorded on the mass spectrum.

- (d) State the **two** measurements that are recorded for each isotope.

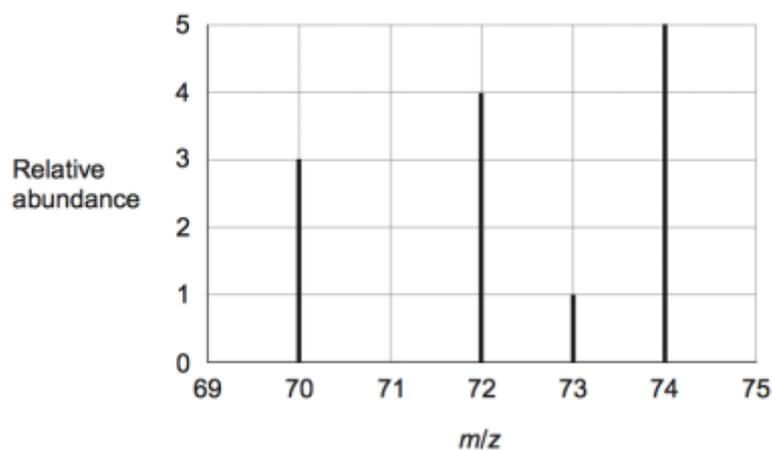
Measurement 1 \_\_\_\_\_

Measurement 2 \_\_\_\_\_

(2 marks)

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- (e) The mass spectrum of the isotopes of element **X** is shown in the diagram.



- (f) Use data from the diagram to calculate the relative atomic mass and the identity of **X**. Give your answer to one decimal place.

Name of element X: \_\_\_\_\_

(4 marks)

- (g) Give the formulae of the ion responsible for the peak at 72

\_\_\_\_\_

(1 mark)

- (h) Identify which **one** of the isotopes of **X** is deflected the most in the magnetic field of a mass spectrometer. Give a reason for your answer.

Isotope \_\_\_\_\_

Reason \_\_\_\_\_

(2 marks)



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- (h) **X** and **Se** are different elements. Explain why the chemical properties of **X** and **Se** are different.

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(1 mark)

**Question 24**

**(5 marks)**

The four major types of bonds are ionic, metallic, covalent and weak intermolecular forces. List which types of bonds are broken in the following changes:

- (a) the melting of sodium nitrate \_\_\_\_\_
- (b) the burning of petrol ( $C_8H_{18}$ ) \_\_\_\_\_
- (c) the boiling of ethanol \_\_\_\_\_
- (d) the sublimation of carbon dioxide \_\_\_\_\_
- (e) the dissolving of ammonium chloride in water \_\_\_\_\_

**Question 25**

**(4 marks)**

Draw the electron dot diagrams (Lewis structures) of the compounds below.

All valence shell electron pairs should be represented as  $:$  or  $-$

PBr <sub>3</sub>	CS <sub>2</sub>
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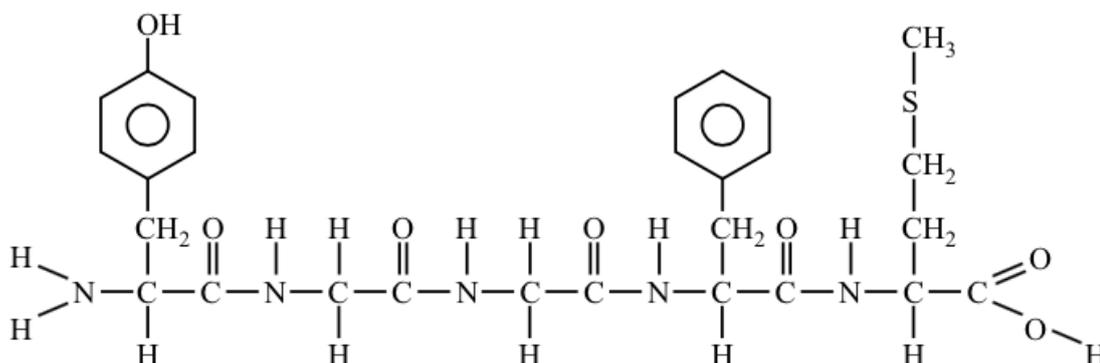
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## Question 26

(9 marks)

Chromatography is often used for the analysis of the mixture of amino acids that is formed when proteins are broken down. The small protein methionine enkephalin has some painkilling activity. The amino acids that make up this protein include methionine, phenylalanine, tyrosine and glycine.

The structure of the protein methionine enkephalin is given below.



- (a) **Circle** a benzene ring in the **above structure** (1 mark)
- (b) Given that the molecular formula of methionine enkephalin is  $C_{27}H_{35}SO_7$ . Calculate the molar mass of the compound. (1 mark)
- (c) How many molecules of methionine enkephalin are there in 6.50g of the molecule?

(2 marks)

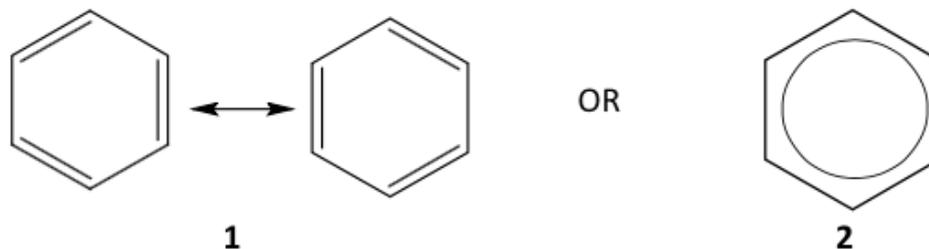
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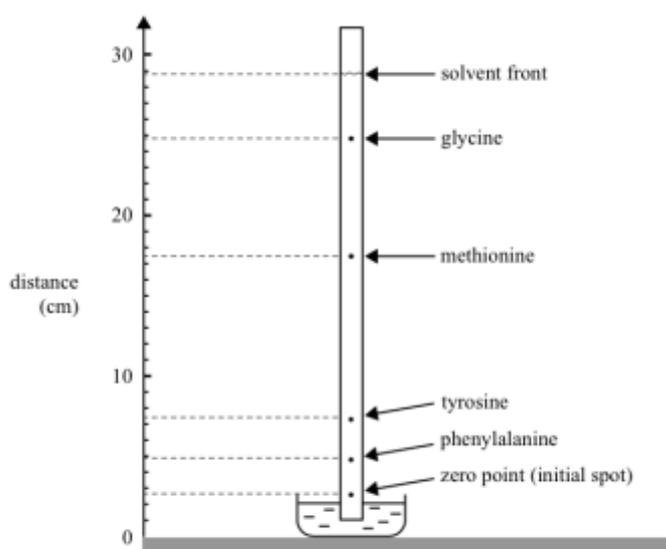
- (d) The structure of benzene is represented by two 6-membered rings with double bonds shown in alternate positions and a double headed arrow between the two 6-membered rings (1) or by a single 6-membered ring with a circle in the centre (2).



Using your knowledge of the structure and bonding of benzene, explain why aromatic compounds like benzene do not undergo addition reactions, like alkenes but reacts via substitution reactions, similar to alkanes.

(2 marks)

An aqueous solution of methionine enkephalin is broken down into its constituent amino acids and the resultant solution of amino acids is subjected to paper chromatography. A strip from such a chromatogram is shown below.



See next page

Amino acids are colourless, but the position of an amino acid spot on the strip can be seen by spraying the strip with a solution of ninhydrin, a substance that reacts with amino acids to produce an intense purple colour.

- a. List the amino acid components in order of decreasing solubility in water. (You may use the first letter of the amino acid to identify it).

Most soluble \_\_\_\_\_ least soluble

(2 marks)

- b. This chromatogram shows a spot of methionine at 17.5 cm on this scale. Calculate the retention factor(  $R_f$ ) value for methionine.

(1 mark)

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## Question 27

(5 marks)

- (a) Write an equation for the reaction of hydrogen with pent-2-ene in the presence of a suitable catalyst

(2 marks)

Equation \_\_\_\_\_

- (b) Draw the structural formula or name the following compounds.

(3 marks)

Name	Structural Formula
trans-1-chloropropene	
	$  \begin{array}{ccccccc}  & & \text{CH}_3 & & \text{CH}_3 & & \\  & &   & &   & & \\  \text{CH}_2 & \text{CH} & \cdot & \text{CH}_2 & \text{C} & \cdot & \text{CH}_3 \\    & & & &   & & \\  \text{CH}_3 & & & & \text{CH}_2 & & \\  & & & &   & & \\  & & & & \text{CH}_3 & &   \end{array}  $
5-ethyl-2,2-dimethyloct-3-ene	

## Question 28

(2 marks)

What is the percentage by mass of water in copper sulfate penta-hydrate  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ?

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## Question 29

(5 marks)

Butane gas burns readily in oxygen to produce carbon dioxide gas and water vapour.

- (a) Write a balanced equation for this reaction. Include all state symbols.

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(2 marks)

- (b) 5.50L of air, which is 20% oxygen by volume, is reacted with an excess of butane. What volume of carbon dioxide gas is produced if the gases are cooled to STP conditions?

(3 marks)

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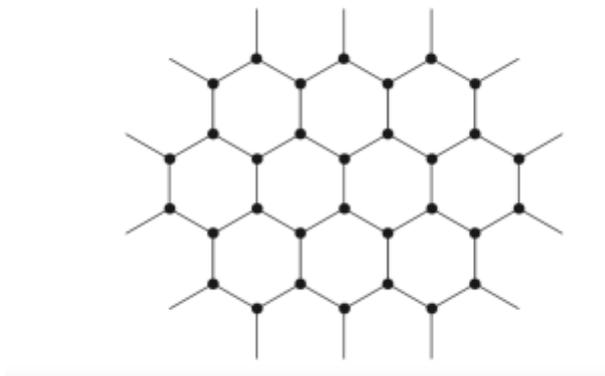
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## Question 30

(8 marks)

Graphene is a new material made from carbon atoms. It is the thinnest and strongest material known and is a single layer of hexagonal planes of carbon atoms. Graphene has an extremely high melting point and is an excellent conductor of electricity. Part of the structure of graphene is illustrated in the diagram.



- (a) Deduce the type of crystal structure shown by graphene.

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(1 mark)

- (b) Suggest why graphene is an excellent conductor of electricity.

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(2 marks)

- (c) Explain, in terms of its structure and bonding, why graphene has a high melting point.

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(2 marks)

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- (d) Titanium is also a strong material that has a high melting point. It has a structure similar to that of magnesium.

State the type of crystal structure shown by titanium.

\_\_\_\_\_

(1 mark)

Titanium can be hammered into objects with different shapes that have similar strengths.

Suggest why titanium can be hammered into different shapes.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(2 marks)

**Question 31**

**(5 marks)**

F<sup>-</sup>, Ne, Na<sup>+</sup> and Mg<sup>2+</sup> all have the same ground state electron configuration.

- (a) What is this electron configuration? \_\_\_\_\_ (1 mark)

- (b) Will the energy required to remove an electron from the different species in (a) be the same or different? Circle your answer.

**Same**

**Different**

- (c) Explain your answer to part (b).

(1 mark)

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(3 marks)

**End of Section Two**



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**See next page**

## Section Three: Extended answer

30% (50 Marks)

This section contains four (4) questions. You must answer all questions. Write your answers in the spaces provided.

Where questions require an explanation and/or description, marks are awarded for the relevant chemical content and also for coherence and clarity of expression.

Final answers to calculations should be expressed to the appropriate number of significant figures and include appropriate units where applicable.

Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.

- Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
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Suggested working time: 50 minutes

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**Question 32****(15 marks)**

Crude oil is a mixture of a very large number of hydrocarbons that can be used as petrol, kerosene, diesel, lubricating oils and waxes.

- (a) Name the process used to separate the hydrocarbons and describe the physical property that allows this separation technique to work successfully.

(2 marks)

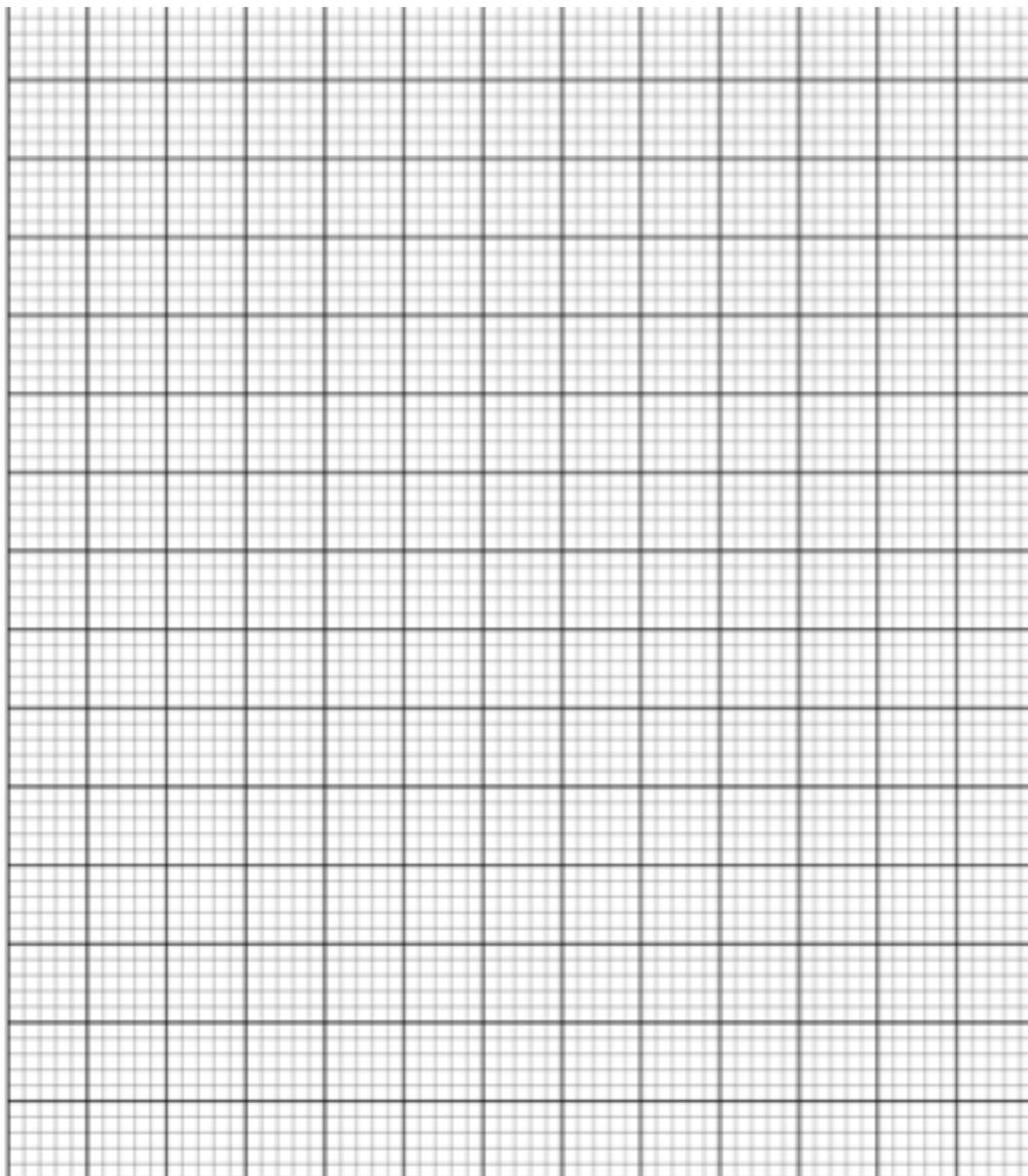
The group of alkanes, or fraction, that has between five and twelve carbon atoms ( $C_5 - C_{12}$ ), is the fraction used in petrol.

The table below gives some of the boiling point values for the **straight chain** alkanes in the  $C_5 - C_{12}$  fraction.

Number of carbon atoms	5	6	8	9	10	11
Approximate boiling points	36	70	125	150	174	200

See next page

- (b) On the grid provided below, plot a graph of the number carbon atoms against their boiling points. (4 marks)



- (c) Using the graph, determine the boiling point of the straight chain alkane that has 7 carbon atoms.  
Boiling point C<sub>7</sub> \_\_\_\_\_ °C (1 mark)
- (d) Extrapolate the graph and predict the boiling point of the straight chain alkane that has 12 carbon atoms.  
Boiling point C<sub>12</sub> \_\_\_\_\_ °C (1 mark)

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Straight chain alkanes with 5-12 carbon atoms are not very suitable for use in automobile engines because they ignite too readily and have a low octane number. This is dangerous as it means that the mixture may explode in the automobile engine.

Branched chain alkanes however ignite at higher temperatures compared to the straight chain alkanes with similar number of carbons. A reforming process involving high temperature and pressure is used to convert the low octane alkanes into fractions that do not burn as readily. In order to meet the demand for these fractions with five to twelve carbons, the heavier fractions are subjected to "cracking" that will break the larger alkanes into smaller branched alkanes.

- (f) Dodecane ( $C_{12}H_{26}$ ) is a liquid hydrocarbon that undergoes thermal cracking to produce but-2-ene and another branched chain alkane, that is a structural isomer of octane.

Draw the structural formulae for the two products.

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(2 marks)

- (g) A student has test tubes containing two different colourless, organic liquids, both with the molecular formula  $C_5H_{10}$ . She decided to carry out a chemical test to distinguish the two and added bromine water to both, mixing the reagents by shaking, being careful to omit any UV light. **The liquids were labelled A and B.** She tabulated her observations below:

Organic liquid	Observations
Liquid A	Immediately decolourised the solution from orange to colourless
Liquid B	Solution remained orange

Further analysis revealed that one of the organic compounds could form geometric isomers. Based on the observations and this information, suggest a possible structure for liquid A and liquid B.

(2 marks)

Structure A

Structure B

See next page

- (h) Write a balanced equation (using structural formula) for the reaction that gave a positive change to the colour of the bromine water above. **Name** the organic product formed. (2marks)

Name of organic product: \_\_\_\_\_

(1 mark)

**Question 33**

**(9 marks)**

Two students were provided with a powdered mixture of calcium phosphate and sodium carbonate and they were carrying out a gravimetric analysis to determine the percentage by mass of calcium phosphate in the mixture.

The students added distilled water to 6.53g mixture of the two compounds until the addition of water results in no further dissolving. They filter the mixture and wash and dry the residue, and measure the mass of the residue. The results are as follows:

Mass of mixture	6.53g
Mass of filter paper	1.56g
Mass of filter paper + residue	5.32g

- (a) Is the original mixture, homogenous or heterogeneous?

\_\_\_\_\_

(1 mark)

- (b) Identify the residue, giving its formula.

\_\_\_\_\_

(1 mark)

- (c) What kind of mixture is the filtrate?

\_\_\_\_\_

(1 mark)

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(d) Calculate the percentage by mass of calcium phosphate in the original mixture.

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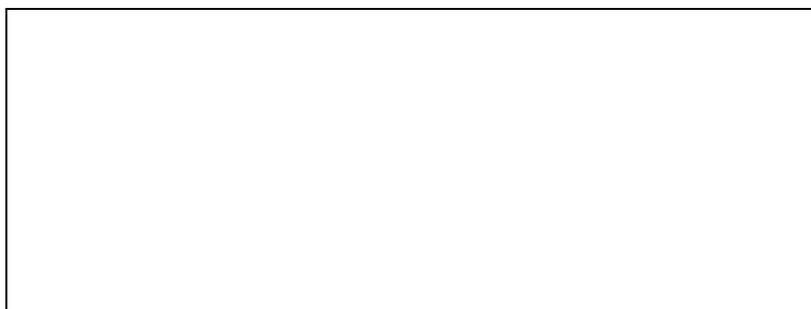
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(2 marks)

(e) Sodium carbonate is not able to conduct electricity in the solid state. Explain.

(2 marks)

(f) Draw an electron dot diagram (Lewis structure) of sodium carbonate.



(2 marks)

**Question 34**

**(17 marks)**

The table below shows physical data for period 3 elements.

Element	Na	Mg	Al	Si	S	P	Cl	Ar
Melting point °C	98	650	659	1410	119	44	-101	-150

Use the data above to answer the following questions.

- (a) Explain in terms of bonding and structure why the melting point increases across the elements Na, Mg and Al.

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(3 marks)

- (b) Write the electron arrangement for  $Mg^+$  ion in its ground state.

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(1 mark)

- (c) Explain what the term **first ionisation** energy means.

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(1 mark)

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(d) Write an equation to represent the 2<sup>nd</sup> ionisation energy of magnesium.

(2 marks)

(e) Explain why the second ionisation energy of magnesium is lower than that of sodium

(3 marks)

(f) Using your understanding of electron arrangement, complete the table and suggest a possible value for the third ionization energy of magnesium

	First	Second	Third	Fourth	Fifth
Ionisation energies of magnesium / kJ mol <sup>-1</sup>	736	1450		10 500	13 629

(1 mark)

(f) State and explain the trends in electronegativity across periods and down group.

Trend down a group: \_\_\_\_\_

Explanation: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Trend across a period: \_\_\_\_\_

Explanation: \_\_\_\_\_

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- (g) Explain how the differences in electronegativity between reacting elements determine whether substances formed are ionic or covalent.

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(6 marks)

**Question 35**

**(9 marks)**

Ammonium nitrate is an important nitrogen rich fertilizer necessary for the growth and well being of plants. Nitrogen helps a plant use carbohydrates to gain energy. It also controls the plant's form and internal function in order to make protein. A commercially available nitrogen rich fertiliser, "Crop-King" has 35.0% ammonium nitrate by mass.

- (a) A 115m<sup>2</sup> garden bed of roses requires 1.20kg of nitrogen weekly to help maintain their growth. What mass of the "Crop-King" fertiliser is required to be administered to the area weekly if it contains 35.0% ammonium nitrate by mass?

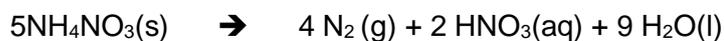
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- (b) Ammonium nitrate is also used as an explosive for detonating buildings. Thermal decomposition of ammonium nitrate in the presence of a catalyst takes place according to the following reaction:



When ammonium nitrate is heated strongly with a catalyst, 60.0L of nitrogen gas is produced when cooled to STP conditions. What mass of ammonium nitrate is required to produce this volume of nitrogen?

(3 marks)

- (c) When the temperature is increased on this system, at constant volume, explain what effect this will have on the pressure of the nitrogen gas inside the reaction vessel.

(2 marks)

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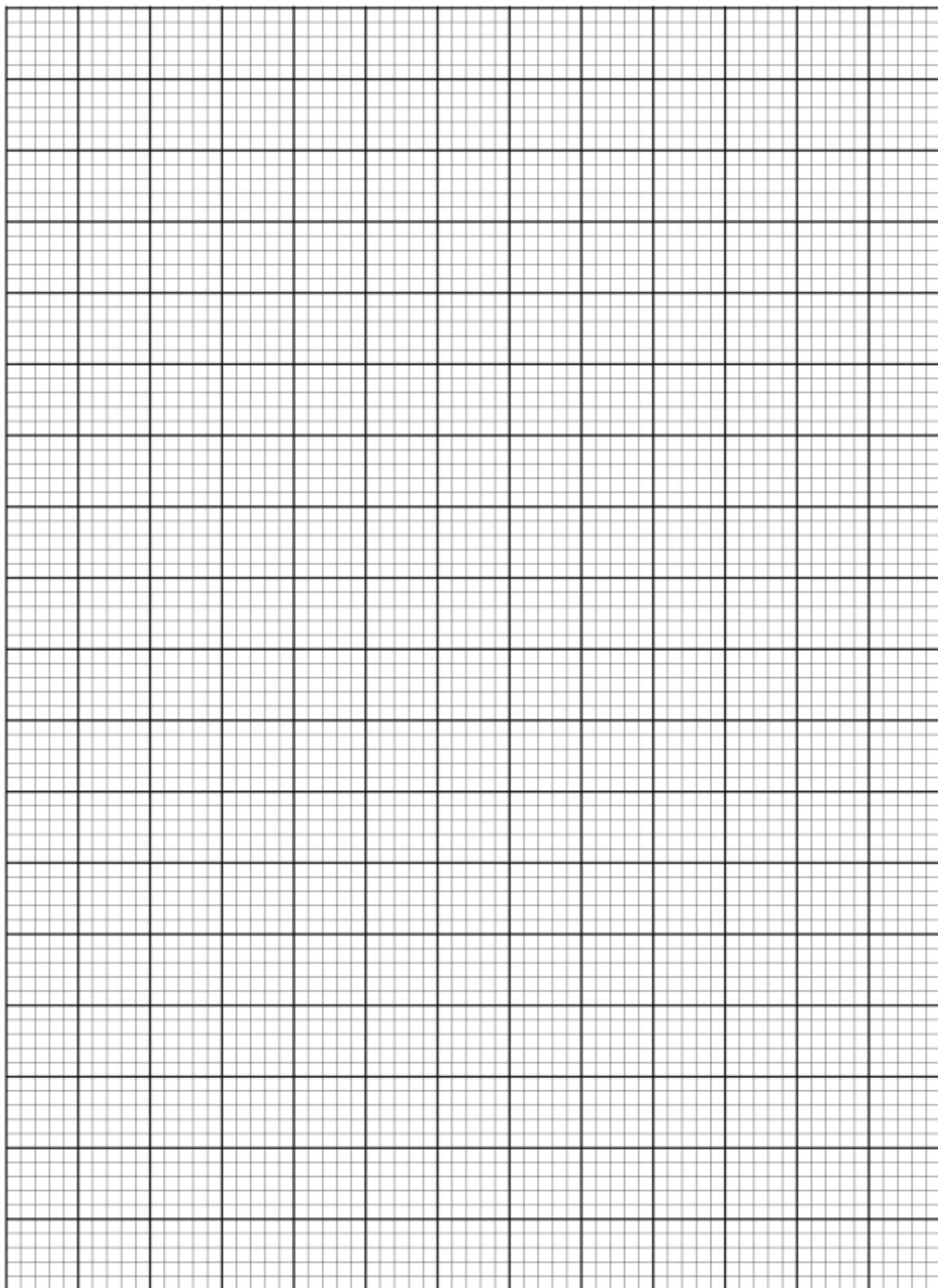
END OF QUESTIONS

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